

APPENDIX C

TMDLS EXPRESSED AS DAILY LOAD

As explained in Section 5.4 of the EPA approved Statewide Bacteria Report, the State of New Hampshire prefers to express bacteria TMDLs as concentrations (counts of bacteria/100mL). However, in accordance with federal guidance, bacteria TMDLs are also expressed as daily loads in terms of mass per unit time [i.e., billions of bacteria per day as a function of flow (for rivers and streams) and daily replacement volume of water for lakes, ponds and coastal embayments. Graphs and tables are provided for single sample and geometric means for E.coli and Enterococci; loads for fecal coliform would be similarly derived.

In contrast to the concentration-based bacteria TMDLs, the MOS in mass per unit time TMDLs is explicit when a discrete portion of the loading capacity is reserved to ensure that water quality standards will be attained. In the example mass per unit time bacteria TMDLs provided below, 10% of the loading capacity is reserved as the MOS, leaving 90% of the TMDL available for allocation among existing and future sources.

Mass per unit time TMDLs for rivers are calculated by multiplying river or stream flow at a given point in time by the allowable bacteria concentration and a conversion factor. If stream-flow data are not available, a range of flows can be assumed based on drainage area. Flows within the assumed range are multiplied by the WQS (both instantaneous and geometric mean concentrations) to obtain the loading capacity or TMDL for the stream segment or watershed. For lakes and ponds or estuarine and marine segments, the daily replacement volume of the water body is multiplied by the WQS concentration. The daily replacement volume is the flushing rate (number of times per year that the volume of the waterbody is completely exchanged), divided by 365, then multiplied by the volume of the water body. Formulas to calculate daily load (mass per unit time) can be found on the following pages.

The following figures contain daily load TMDL calculations for bacteria-impaired rivers and streams, lakes and ponds, and coastal embayments in New Hampshire. These figures are intended to provide the necessary formulas, tables, and graphs required for calculating bacteria TMDLs for any bacteria-impaired waterbody, and for any flow and/or volume.

Daily load (mass per unit time) bacteria TMDLs are presented for:

- ***Class B Freshwater Rivers & Streams*** - Figure 1 shows TMDLs for these waters based on the single sample criterion for primary contact recreation of 406 *E.coli* per 100mL; Figure 2 shows TMDLs based on the geometric mean criterion for primary contact recreation of 126 *E.coli* per 100mL. These are flow-based daily load calculations for Class B freshwater rivers and streams.
- ***Class B Freshwater Lakes & Ponds*** - Figure 3 shows TMDLs for these waters based on the single sample criterion for primary contact recreation of 406 *E.coli* per 100mL; Figure 4 shows TMDLs based on the geometric mean criterion for primary contact recreation of 126 *E.coli* per 100mL. These daily load calculations for Class B freshwater lakes and ponds are based on the daily replacement volume, which is the volume of the water body that is exchanged each day upon a flushing time of one day.
- ***Class B Coastal Embayments*** - Figure 5 shows TMDLs for these waters based on the single sample criterion for primary contact recreation of 104 Enterococci per 100mL; Figure 6 shows TMDLs based on the geometric mean criterion for primary contact recreation of 35 Enterococci per 100mL. These daily load calculations for Class B coastal embayments are based on the daily replacement volume, which is the volume of the water body that is exchanged each day.

Figure 1: Freshwater River & Stream Daily Loads based on SS WQS.

Flow (cfs)	SS WQS (#/100mL)	SS TMDL	MOS	LA and WLA
billions of organisms/day				
0.5	406	5.0	0.5	4.5
1	406	9.9	1.0	8.9
2	406	19.9	2.0	17.9
3	406	29.8	3.0	26.8
4	406	39.7	4.0	35.8
5	406	49.7	5.0	44.7
10	406	99.3	9.9	89.4
20	406	198.7	19.9	178.8
50	406	496.7	49.7	447.0
75	406	745.1	74.5	670.6
100	406	993.4	99.3	894.1

Abbreviations:

SS WQS = Single Sample Water Quality Standard; SS TMDL = Single Sample Total Maximum Daily Load

WLA_c = Waste Load Allocations for continuous point source discharges and all NPDES discharges other than Stormwater WLA

Stormwater WLA = Waste Load Allocations for all NPDES-regulated stormwater

LA = Load Allocations for all non-point sources of bacteria which includes all sources not regulated under the NPDES permit program.

MOS = Margin of Safety – set equal to 10% of single sample WQS.

Formula:

TMDL (billions of organisms per day) = WQS (#/100mL) x 1000 (mL/L) x Q (ft³/sec) x 86400 (sec/day) x 28.32 (L/ft³)/10⁹

Where:

WQS = 406/100mL *E. coli*

Q = Flow in cubic feet/second (ft³/sec)

mL = milliliter; L = Liter

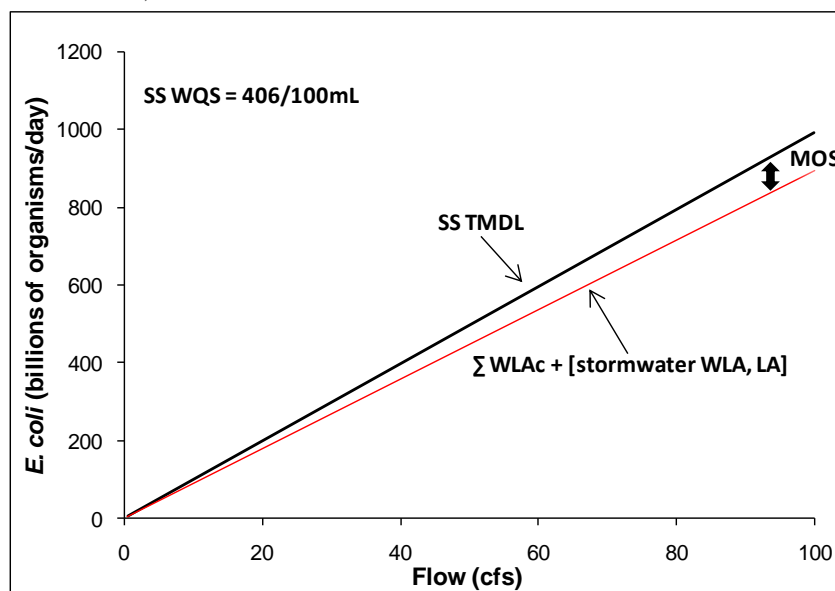


Figure 2: Freshwater River & Stream Daily Loads based on GM WQS.

Flow (cfs)	GM WQS (#/100mL)	GM TMDL	MOS	LA and WLA
billions of organisms/day				
0.5	126	1.5	0.2	1.4
1	126	3.1	0.3	2.8
2	126	6.2	0.6	5.5
3	126	9.2	0.9	8.3
4	126	12.3	1.2	11.1
5	126	15.4	1.5	13.9
10	126	30.8	3.1	27.7
20	126	61.7	6.2	55.5
50	126	154.2	15.4	138.7
75	126	231.2	23.1	208.1
100	126	308.3	30.8	277.5

Abbreviations:

GM WQS = Geometric Mean Water Quality Standard; GM TMDL = Geometric Mean Total Maximum Daily Load

WLA_c = Waste Load Allocations for continuous point source discharges and all NPDES discharges other than Stormwater WLA

Stormwater WLA = Waste Load Allocations for all NPDES-regulated stormwater

LA = Load Allocation for all non-point sources of bacteria which includes all sources not regulated under the NPDES permit program.

MOS = Margin of Safety – set equal to 10% of geometric mean WQS.

Formula:

TMDL (billions of organisms per day) = WQS (#/100mL) x 1000 (mL/L) x Q (ft³/sec) x 86400 (sec/day) x 28.32 (L/ft³)/10⁹

Where:

WQS = 126/100mL *E. coli*

Q = Flow in cubic feet/second (ft³/sec)

mL = milliliter; L = Liter

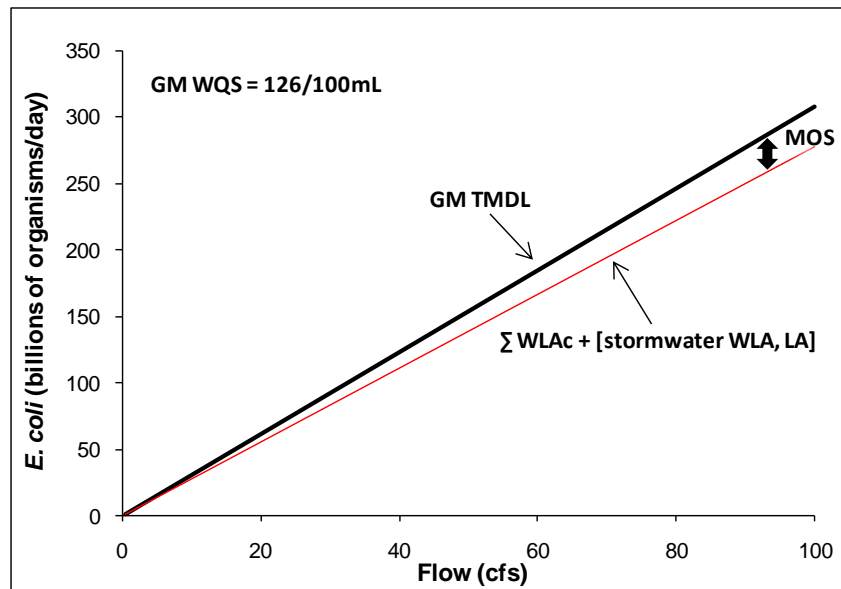


Figure 3: Freshwater Lakes & Ponds Daily Loads based on SS WQS.

Daily Replacement Volume (ft ³)	SS WQS (#/100mL)	SS TMDL	MOS	LA and WLA
billions of organisms/day				
1000	406	0.1	0.01	0.10
5000	406	0.6	0.06	0.52
10000	406	1.1	0.11	1.03
50000	406	5.7	0.57	5.17
100000	406	11.5	1.15	10.35
500000	406	57.5	5.75	51.74
1000000	406	115.0	11.50	103.48

Abbreviations:

SS WQS = Single Sample Water Quality Standard; SS TMDL = Single Sample Total Maximum Daily Load

WLAc = Waste Load Allocations for continuous point source discharges and all NPDES discharges other than Stormwater WLA

Stormwater WLA = Waste Load Allocations for all NPDES-regulated stormwater

LA = Load Allocation for all non-point sources of bacteria which includes all sources not regulated under the NPDES permit program.

MOS = Margin of Safety – set equal to 10% of single sample WQS.

Formula:

TMDL (billions of organisms per day) = WQS (#/100mL) x Volume (ft³) x 1000 (mL/L) x 28.32 (L/ft³)/10⁹

Where: WQS = 406/100mL *E. coli*

Daily Replacement Volume = (Annual flushing rate/365) x Water Body Volume in cubic feet (ft³)

Annual flushing Rate – number of times per year the waterbody's volume is exchanged

mL = milliliter; L = Liter

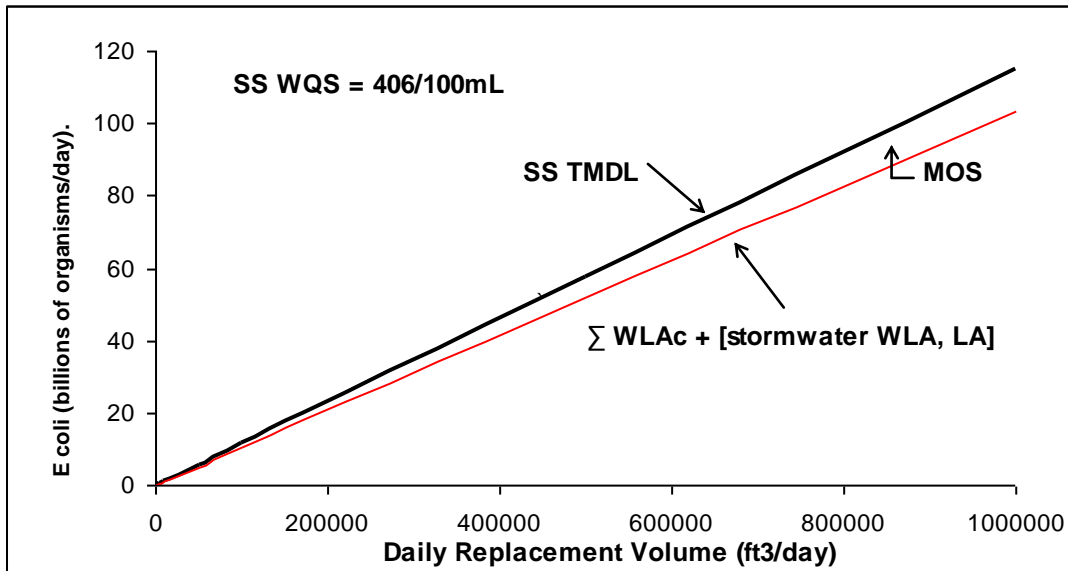


Figure 4: Freshwater Lakes & Ponds Daily Loads based on GM WQS.

Daily Replacement Volume (ft ³)	GM WQS (#/100mL)	GM TMDL	MOS	LA and WLA
billions of organisms/day				
1000	126	0.04	0.004	0.032
5000	126	0.18	0.018	0.161
10000	126	0.36	0.036	0.321
50000	126	1.78	0.178	1.606
100000	126	3.57	0.357	3.211
500000	126	17.84	1.784	16.057
1000000	126	35.68	3.568	32.115

Abbreviations:

GM WQS = Geometric Mean Water Quality Standard; GM TMDL = Geometric Mean Total Maximum Daily Load

WLA_c = Waste Load Allocations for continuous point source discharges and all NPDES discharges other than Stormwater WLA

Stormwater WLA = Waste Load Allocations for all NPDES-regulated stormwater

LA = Load Allocation for all non-point sources of bacteria which includes all sources not regulated under the NPDES permit program.

MOS = Margin of Safety – set equal to 10% of geometric mean WQS.

Formula:

TMDL (billions of organisms per day) = WQS (#/100mL) x Volume (ft³) x 1000 (mL/L) x 28.32 (L/ft³)/10⁹

Where:

WQS = 126/100mL *E. coli*

Daily Replacement Volume = (Annual flushing rate/365) x Water Body Volume in cubic feet (ft³)

Annual flushing Rate – number of times per year the waterbody's volume is exchanged

mL = milliliter; L = Liter

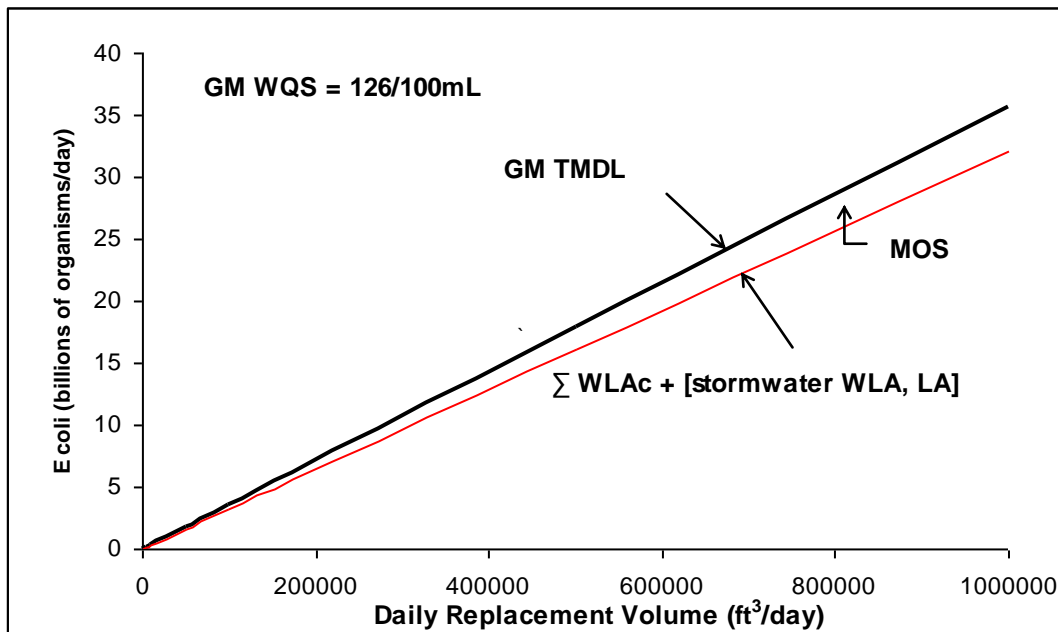


Figure 5: Coastal Embayment Daily Loads based on Enterococcus SS WQS.

Daily Replacement Volume (ft ³)	SS WQS (#/100mL)	SS TMDL	MOS	LA and WLA
billions of organisms/day				
1000	104	0.03	0.003	0.027
5000	104	0.15	0.015	0.133
10000	104	0.29	0.029	0.265
50000	104	1.47	0.147	1.325
100000	104	2.95	0.295	2.651
500000	104	14.73	1.473	13.254
1000000	104	29.45	2.945	26.508

Abbreviations:

SS WQS = Single Sample Water Quality Standard; SS TMDL = Single Sample Total Maximum Daily Load

WLA_c = Waste Load Allocations for continuous point source discharges and all NPDES discharges other than Stormwater WLA

Stormwater WLA = Waste Load Allocations for all NPDES-regulated stormwater

LA = Load Allocation for all non-point sources of bacteria which includes all sources not regulated under the NPDES permit program.

MOS = Margin of Safety – set equal to 10% of single sample WQS.

Formula:

TMDL (billions of organisms per day) = WQS (#/100mL) x Volume (ft³) x 1000 (mL/L) x 28.32 (L/ft³)/10⁹

Where: WQS = 104/100mL *Enterococcus*

Daily Replacement Volume = (Annual flushing rate/365) x Water Body Volume in cubic feet (ft³)

Annual flushing Rate – number of times per year the waterbody's volume is exchanged

mL = milliliter; L = Liter

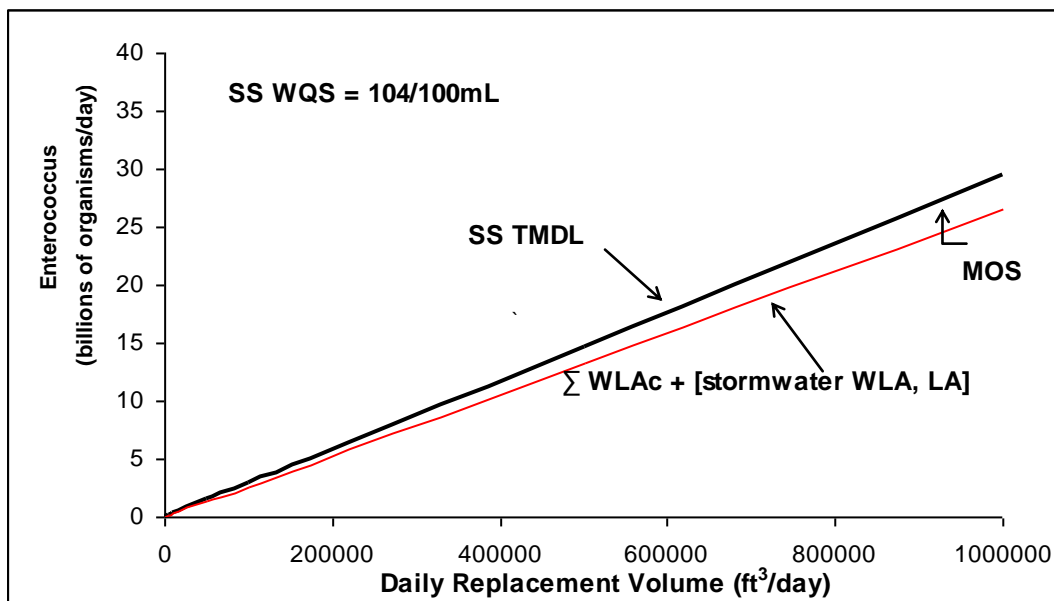


Figure 6: Coastal Embayment Daily Loads based on Enterococcus GM WQS.

Daily Replacement Volume (ft ³)	GM WQS (#/100mL)	GM TMDL	MOS	LA and WLA
billions of organisms/day				
1000	35	0.01	0.001	0.009
5000	35	0.05	0.005	0.045
10000	35	0.10	0.010	0.089
50000	35	0.50	0.050	0.446
100000	35	0.99	0.099	0.892
500000	35	4.96	0.496	4.460
1000000	35	9.91	0.991	8.921

Abbreviations:

GM WQS = Geometric Mean Water Quality Standard; GM TMDL = Geometric Mean Total Maximum Daily Load

WLA_c = Waste Load Allocations for continuous point source discharges and all NPDES discharges other than Stormwater WLA

Stormwater WLA = Waste Load Allocations for all NPDES-regulated stormwater

LA = Load Allocation for all non-point sources of bacteria which includes all sources not regulated under the NPDES permit program.

MOS = Margin of Safety – set equal to 10% of geometric mean WQS.

Formula:

TMDL (billions of organisms per day) = WQS (#/100mL) x Volume (ft³) x 1000 (mL/L) x 28.32 (L/ft³)/10⁹

Where: WQS = 35/100mL *Enterococcus*

Daily Replacement Volume = (Annual flushing rate/365) x Water Body Volume in cubic feet (ft³)

Annual flushing Rate – number of times per year the waterbody's volume is exchanged

mL = milliliter; L = Liter

